Sinusoidally-driven flat-ended indentation of time-dependent materials: Asymptotic modelling

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In recent years, a sinusoidally-driven indentation test was shown to be effective for viability characterization of articular cartilage. The mathematical analysis of dynamic indentation experiments for a time-dependent material requires a complete understanding of the material damping characteristics. It is assumed that the mechanical response of the articular cartilage layer can be described in the framework of viscoelastic model with time-independent Poisson's ratio such that the overall constitutive behavior is expressed in terms of the complex modulus. Based on the elastic-viscoelastic correspondence principle, the governing integral equation of the associated dynamic contact problem is formulated, and a closed-form analytical solution for the integral characteristics of the indentation test is obtain. An asymptotic modeling approach is then applied for analyzing and interpreting the results of the dynamic indentation test in terms of the storage modulus and the loss angle of the viscoelastic material.